

U.S. Department of Transportation
Federal Aviation Administration

Subject: INFORMATION: Airplane Operation with Air
Conditioning Packs-Off, Revision to Memorandum of
June 28, 1999, same subject

Date:

From: Manager, Transport Standards Staff, ANM-110

Reply to
Attn. of:

To: SEE DISTRIBUTION

References:

- (1) Seattle Aircraft Certification Office (ACO) and Transport Standards Staff (TSS) meeting of May 12, 1999
- (2) FAA memorandum dated May 20, 1983, subject: Mitsubishi MU-300
- (3) AC No. 25-20, "Pressurization, Ventilation, and Oxygen Systems Assessment for Subsonic Flight Including High altitude Operation," dated September 10, 1996
- (4) Draft AC 25-XX, "Certification of Transport Airplane Mechanical Systems," dated November 30, 1998 (also called Mega AC)
- (5) Seattle ACO and TSS meeting of July 23, 1999

Issue: The Seattle ACO is currently reviewing the design of the Boeing Model 767-400ER. The SACO has asked the TSS to clarify certification policies regarding cabin ventilation and cargo smoke detection relative to air conditioning (AC) packs-off operation (reference (1)). During the reference (5) meeting, the Seattle ACO personnel requested further clarification regarding the issue of smoke penetration into the passenger cabin during the packs-off operation mode. The conclusion section of this memorandum has been revised to address that issue. In addition, an example of how to define the maximum period of operation in the packs-off mode is also provided.

Background: The following summarizes some key elements that are necessary to understand in determining the certification policy regarding cabin ventilation smoke detection and evacuation, and equipment cooling:

The cabin ventilation regulatory standards for the 767-400ER, which is a derivative model, are located in § 25.831, as amended by Amendment 25-41. The original Model 767 compliance finding for this regulation did not document any consideration of airplane operations with the AC packs-off although the airplane flight manual (AFM) allows such an operation.

The provisions of § 25.831(a), as amended by Amendment 25-41, state: "Each passenger and crew compartment must be ventilated, and each crew compartment must have enough fresh air (but not less than 10 cu. ft. per minute per crewmember) to enable crewmembers to perform their duties without undue discomfort or fatigue."

In 1983, a memorandum addressing AC packs-off operation for the MU-300 (reference (2)) was written by the TSS. The memorandum provides additional guidance to the regulatory provisions of § 25.831(a), as amended by Amendment 25-41. The memorandum states: “The proposed environmental control system (ECS) takeoff procedure for the MU-300 should be processed for certification by an exemption to 25.831(a).” The memorandum also states: “Analysis and tests have been used to substantiate that operating without the required 10 cubic feet per minute per pilot (FAR 25.831(a)) for short duration will not impair pilot performance or significantly affect equipment reliability. This is not to say that the pilots need be comfortable. These ECS “off” approvals were made in accordance with adequate criteria, but not all were made in accordance with correct certification procedures (i.e., equivalency or exemption).”

Subsequently, Amendment 25-87, effective April 30, 1998, amended several of the airworthiness provisions concerning cabin ventilation. Section 25.831(a) was changed to require that, “...the ventilation system must be designed to provide a sufficient amount of uncontaminated air to enable the crewmembers to perform their duties without undue discomfort or fatigue and to provide reasonable passenger comfort. For normal operating conditions, the ventilation system must be designed to provide each occupant with an airflow containing at least 0.55 pounds of fresh air per minute.”

The preamble to Amendment 25-87 adds the following additional information: “One commenter recommends allowing the fresh air requirements proposed to be required under § 25.831(a) to remain a crewmember requirement only. The Federal Aviation Administration (FAA) does not concur with this recommendation. It has been determined that this level of airflow is required for several reasons. Members of the flightcrew performing their functions in the passenger cabin are not sedentary and must perform their duties without undue discomfort or fatigue. In addition, fresh airflow has been determined to be necessary to provide adequate smoke clearance in the event of smoke accumulation due to a system failure or fire. However, it is clear that the additional airflow is not required at all times and under all operating conditions. Therefore, the wording in the final rule has been changed to state that the ventilation system must be designed to provide the fresh airflow. This also addresses concerns regarding the low fresh airflow capability that occurs during descent at low power levels.”

The development of AC 25-20 was concurrent with Amendment 25-87. Paragraph 5d states: “Takeoff with air conditioning or bleed air system “off” may be an acceptable procedure provided the ventilation system continues to provide an acceptable environment in the passenger cabin and cockpit for the brief period when the ventilation system is not operating normally.”

The draft mechanical system mega AC (reference (4)) that was issued for public comment, as well as coordinated for directorate comments, includes a statement that recommends that the exemption process be used to approve the cabin ventilation system for operation with AC packs-off operation. However, the Aerospace Industries Association (AIA) has questioned the need for an exemption and stated that the no packs takeoff procedures already exists; that as the transient for this condition is short, this is an accepted practice; and that it does not cause the cabin environment to be unsafe. In addition, the Los Angeles ACO commented that an equivalent safety finding was more appropriate than an exemption.

Analysis: The TSS’s interpretation of the provisions of § 25.831(a), as amended by Amendment 25-41, is the prescribed airflow for the flightcrew is required to be provided during normal operation. However, the certification records do not show that any such equivalent safety finding or exemption for AC packs-off operation (i.e., no fresh air for crewmembers) was issued for the MU-300 or for any other transport category airplane. Therefore, the TSS assumes that any transport category airplane for which the AFM

allows packs-off operation, does not strictly comply with the provision of § 25.831(a), as amended by Amendment 25-41.

As discussed above, recognizing that the cabin ventilation provisions of Amendment 25-41 were overly restrictive, the FAA, in Amendment 25-87, changed the requirement of § 25.831 so that the regulatory provision now reads, "...the ventilation system must be designed to provide a sufficient amount of uncontaminated air to enable crewmembers to perform their duties without undue discomfort or fatigue...."

The preamble discussion quoted above states that the reason for this change is that, "...it is clear that the additional airflow is not required at all times and under all operating conditions."

Therefore, provisions of § 25.831, as amended by Amendment 25-87, specify a design requirement and allow for limited interruptions of the specified design airflow. However, this interruption may not result in "undue" discomfort or fatigue to the crewmembers. Advisory Circular 25-20, which was developed concurrently with Amendment 25-87, supports this interpretation (see excerpt above).

Furthermore, the ValuJet accident heightened FAA awareness to the need to address smoke penetration and include cargo compartment fire protection (detection and suppression) throughout the flight, including taxi, takeoff and climb. When determining compliance with the sections of part 25 relating to flightcrew compartment air quality, ventilation, smoke penetration/evacuation, cargo compartment fire protection (detection and suppression) and equipment cooling, all the impacts related to operating with the AC packs off for a limited time must be determined. The TSS considers the failure to document any consideration of these issues in previous compliance findings an oversight by the FAA.

The TSS will modify the mechanical systems mega AC to explain that while direct compliance to § 25.831(a), as amended by Amendment 25-87, for AC packs-off operation is possible without using an equivalent safety finding; an equivalent safety finding (§ 21.21(b)(1)) may be used for showing compliance with the provisions of § 25.831(a), as amended by Amendment 25-41, for AC packs-off operation.

Conclusion: The TSS has determined that while direct compliance to § 25.831(a), as amended by Amendment 25-87, for AC packs-off operation is possible without using an equivalent safety finding, an equivalent safety finding (§ 21.21(b)(1)) may be used for showing similar compliance with the provisions of § 25.831(a), as amended by Amendment 25-41. The equivalent safety finding must document that the ventilation system continues to provide an acceptable environment in the passenger cabin and cockpit for the brief period when the ventilation system is not operating normally. The degradation of crewmember air quality must not reach a level that would cause undue discomfort and fatigue to the point that it could affect the performance of their duties.

Also note that AC 25.1581-1, "Airplane Flight Manual," issued in 1997, states in paragraph 2b(11), "Systems and Equipment Limitations," that; "all limitations applicable to systems and equipment installations that are considered necessary for safe operation must be included". Operation with AC packs-off is intended to be a short duration operation. Therefore, the maximum period of operation in this configuration should be defined by the applicant and specified in the AFM, along with any related operating procedures necessary to maintain compliance with the regulatory issues discussed above. An example of establishing "the maximum period of operation (short duration) for takeoff" would be an operational phase beginning with turning packs off when cleared into position for takeoff, and ending

when packs were turned back on after takeoff thrust was reduced to climb thrust or when accomplishing the "after-takeoff" checklist.

In accordance with §25.855 and § 25.857, there must be a means to exclude hazardous quantities of smoke, flames, or extinguishing agent from any compartment occupied by crew or passengers. The FAA has historically found compliance to these requirements for packs on operation but has not recognized the need to assess compliance with requirements for limited duration packs off operation. A change in precedent set by historical practice is beyond the scope of this informational memorandum. The TSS recognizes that service experience to date has not demonstrated that packs-off operations has resulted in hazardous quantities of smoke.

Therefore, at this time, determination that packs-off operation is acceptable can be predicated on an FAA finding that no unsafe condition due to limited duration packs-off operation would result should a cargo compartment fire occur. Criteria that should be considered include; (1) packs-on operation will not allow any smoke from the cargo compartment to penetrate the passenger compartment; and (2) during limited duration packs-off operation the cargo compartment smoke detection system is effective and the AC packs can be turned on and returned to the approved packs-on configuration to exclude hazardous quantities of smoke. The local ACO may make a determination of compliance to the aforementioned criteria based upon available test data, analysis and extrapolation of these data, as has been historically accepted to demonstrate compliance to these and other sections of part 25.

In the future, the TSS will fully evaluate the sufficiency of these enumerated criteria for demonstrating compliance and, if appropriate, provide additional considerations for determining compliance of packs off operation.

If you have further questions, the person on my staff most familiar with this issue is Mr. Steve Happenny. Mr. Happenny can be reached at (425) 227-2147.

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ANM-113

ANM-116

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